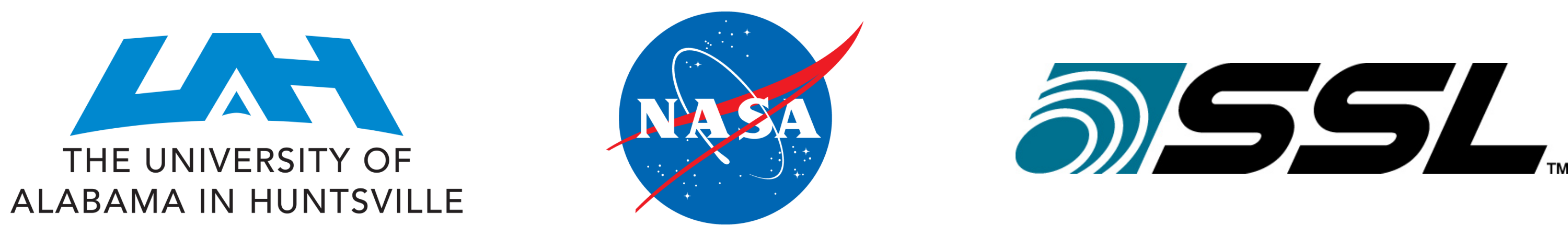


By-Pass Diode Temperature Tests of a Solar Array Coupon under Space Thermal Environment Conditions

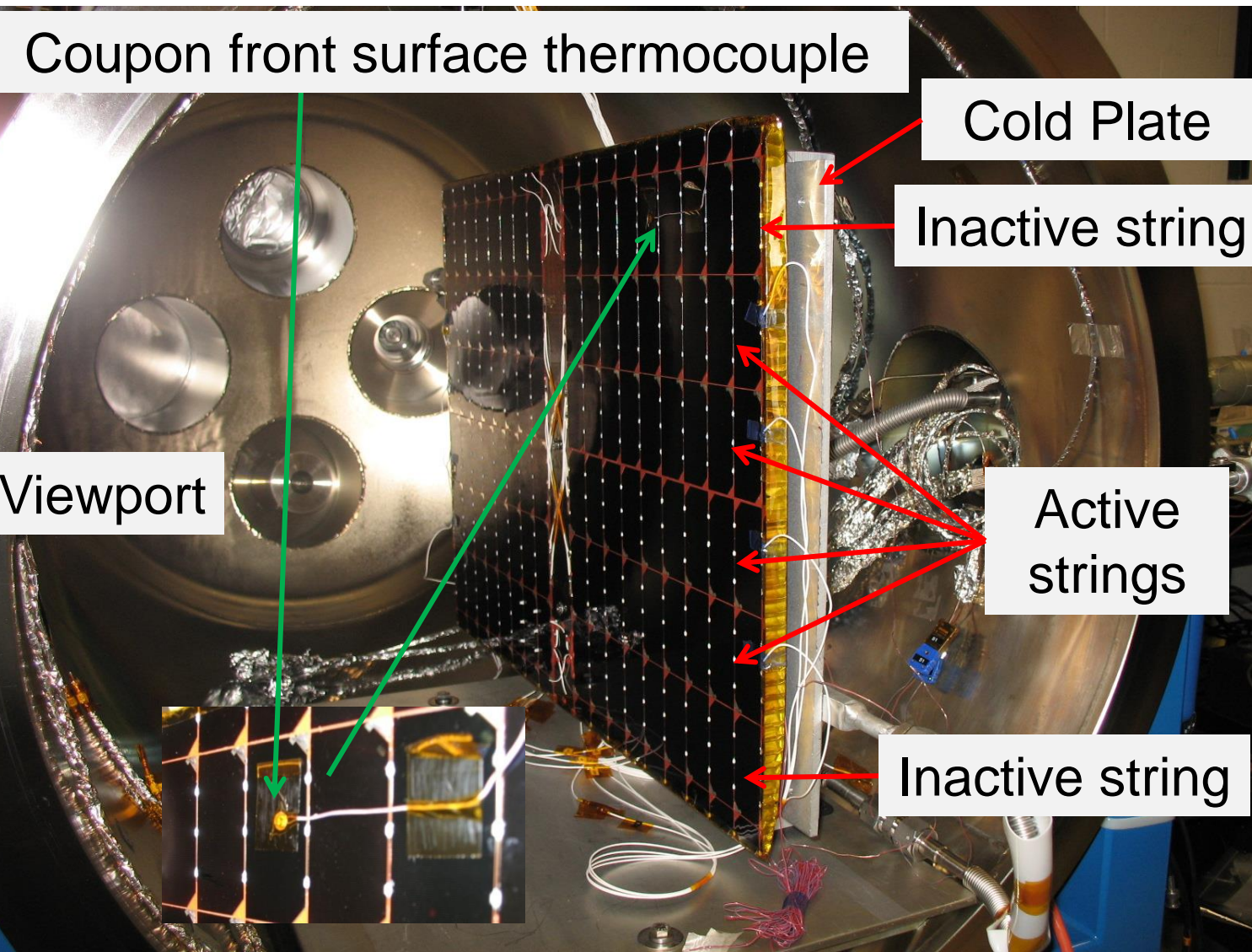
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Introduction

- By-Pass diodes are a key design feature of solar arrays and system design must be robust against local heating, especially with implementation of larger solar cells
- By-Pass diode testing was performed to aid thermal model development for use in future array designs that utilize larger cell sizes that result in higher string currents
- Testing was performed on a 56-cell Advanced Triple Junction solar array coupon provided by SSL
- Test conditions were vacuum with cold array backside using discrete by-pass diode current steps of 0.25 A ranging from 0 A to 2.0 A

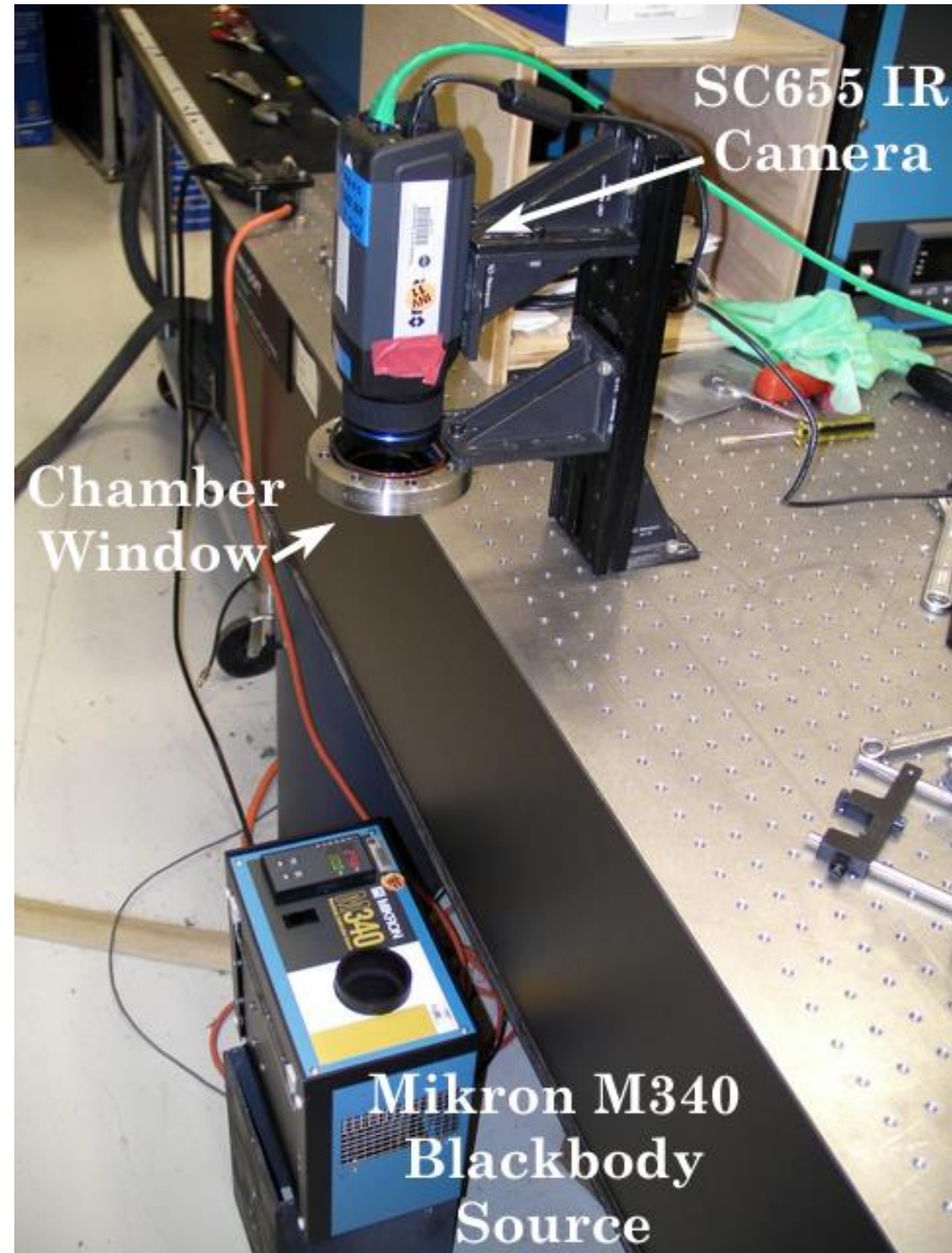
Experiment Setup



- MSFC chamber dimensions: 1m dia. and 2 m length
- Vacuum: Oil-free pumping to reach in the 10^{-5} Pa (10^{-7} Torr) range
- LN₂ Cold Plate facing coupon backside
 - Test 1: 3.8 cm gap between coupon and cold plate with LN₂ and 150 C limit
 - Test 2: coupon and cold plate in direct contact with LN₂ and no temperature limit
 - Test 3: coupon and cold plate in direct contact without LN₂ and no temperature limit

- Thermocouples mounted on coupon front and back continuously monitored during test
- Periodic IR thermal images obtained when diodes reach ~ thermal equilibrium

Calibration of thermal image system

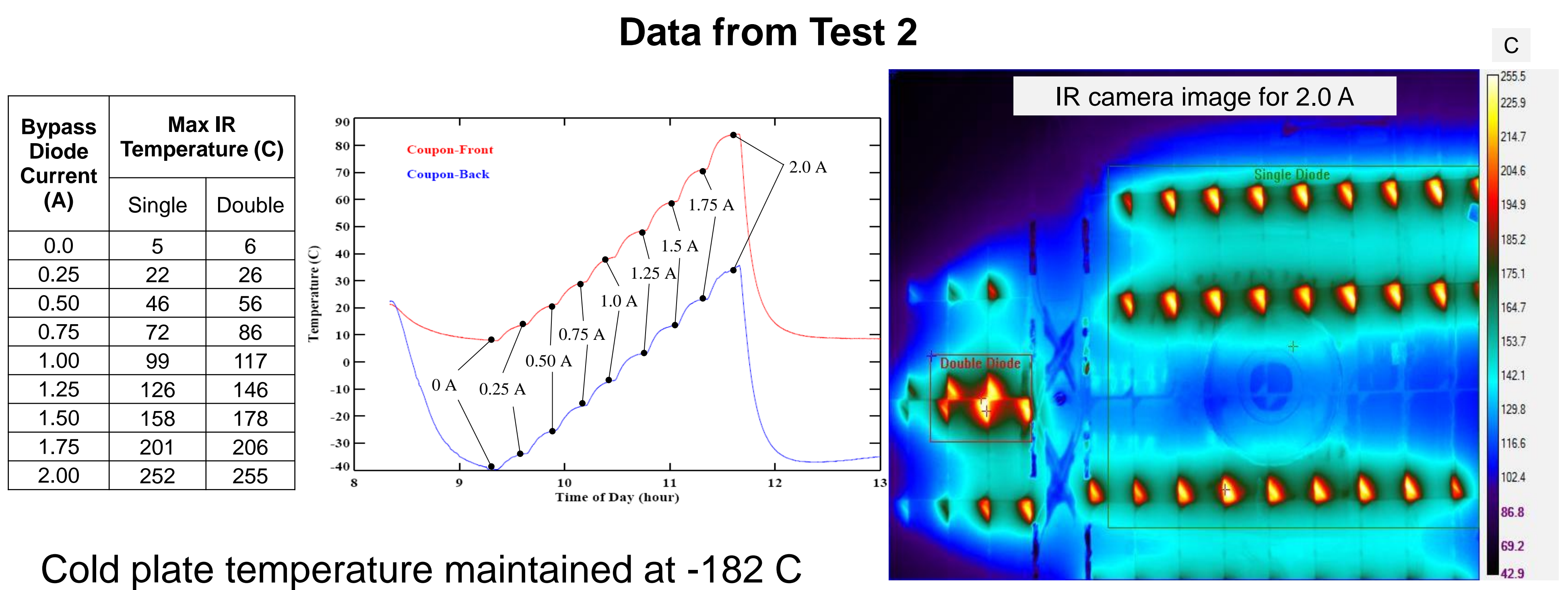
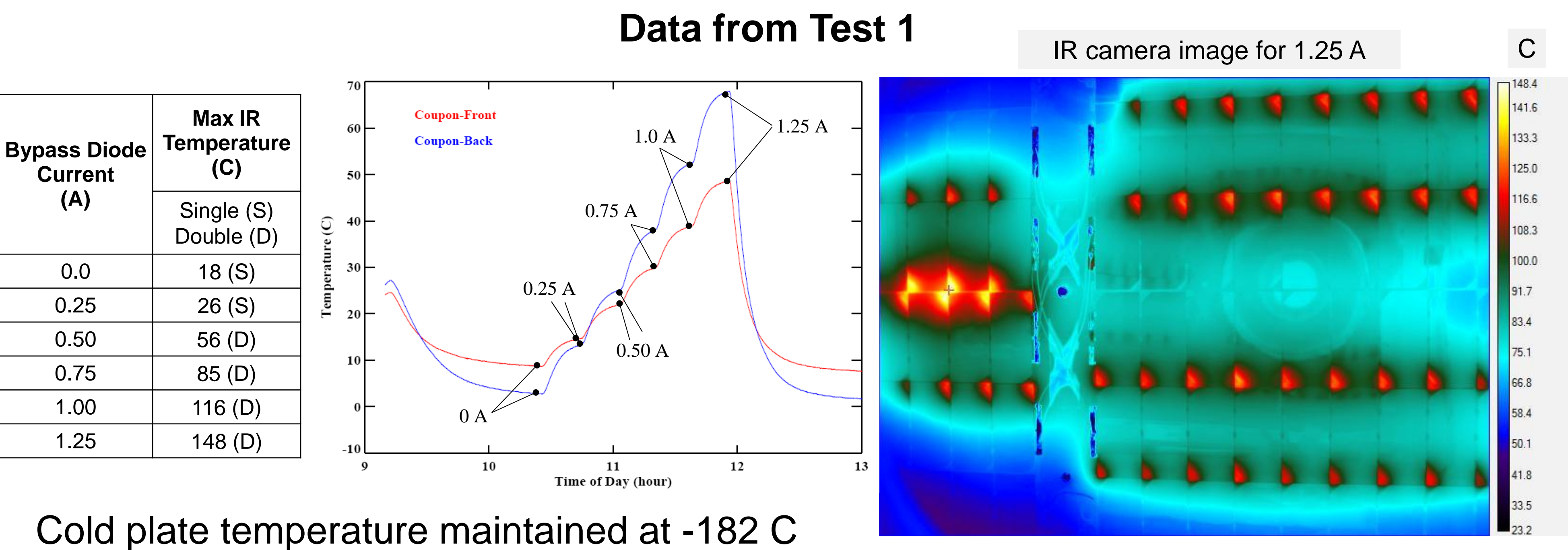


- FLIR SC655 IR Camera
- Calibration performed with same attributes as used in the test
 - Same optics (coverglass and ZnSe viewport)
 - Same separation distance: (1) camera-to-viewport at 2.5 cm and (2) viewport-to-coverglass at 58 cm
- Mikron M340 blackbody used for known temperature reference.
 - Range: -20 C to 150 C with active cooling so that equilibrium times are short for scanning in both directions.

Reference

P. R. Sharps, M. A. Stan, D. J. Aiken, B. Clevenger, J. S. Hills, and N. S. Fatemi, "Multi-junction cells with monolithic bypass diodes", white paper, EMCORE Photovoltaics (now SolAero Technologies)

Test Results



SSL Thermal Model

- Test results were used to correlate thermal analysis and to determine design limits of array designs with larger solar cells. Coupon backside facing deep space.

